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New coniferous foliage shoot from the Lower Gondwana beds of India

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ABSTRACT

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The morphological and cuticular features of new sterile, branched coniferous foliage shoot, *Walkomiella sahnii* sp. nov. collected from the carbonaceous shale samples of Karharbari Formation, Rajhara Colliery of Daltonganj Coalfield, Jharkhand State are described. New species is characterized by homomorphic leaves showing rhomboidal shape, acuminate apex, broad base, uninerved; cuticle is differentiated into thick abaxial and thin adaxial surfaces and stomata are irregularly distributed only on adaxial surface. Fertile structures are not known. Specimen represents the first report of *Walkomiella* as coalified compression in Lower Gondwana sediments of India. Earlier records of W. *indica* Surange & Singh 1951 and *Walkomiella* sp. are based on dispersed cuticles of leaf and seed bearing shoot recovered through maceration of samples.

Key-words—*Walkomiella sahnii* sp. nov., Conifer, Morphology, Cuticle, Lower Gondwana, Lower Permian.

भारत के निम्न गोंडवाना संस्तरों से प्राप्त नवीन शंकुधारी पर्णी प्ररोह

ए.के. श्रीवास्तव एवं दीपा अग्निहोत्री

सारांश

झारखंड राज्य में डाल्टनगंज कोयला क्षेत्र की राजहरा कोयला खदान की करहरबारी शैलसमूह के कार्बनी शैल नमूनों से संगृहीत नवीन अनुर्वर, शाखित शंकुधारी पर्णी प्ररोह, *वाल्कोमियेला साहनाई* नवजाति के आकारिकीय एवं उपत्वचीय लक्षण वर्णित किए हैं। नवीन जाति चतुष्कोणी आकार, लंबाग्र शिखर, विस्तृत आधार, एकशिरीय दर्शाते हुए केवल एक प्रकार की पत्ती अर्थात समरूपी द्वारा अभिलक्षणित है; उपत्वचा मोटी अपाक्ष एवं तनु अभ्यक्ष पृष्ठों में वर्गीकृत है तथा रंध्र केवल अभ्यक्ष पृष्ठ पर अनियमित रूप से वितरित हैं। फलद संरचनाओं की जानकारी नहीं हैं। नमूना भारत के निम्न गोंडवाना अवसादों में कोयलित संपीडाश्म के रूप में *वाल्कोमियेला* का प्रथम अभिलेख निरुपित करता है। *वाल्कोमियेला इंडिका* सुरंगे व सिंह 1951 एवं *वाल्कोमियेला* जाति के पूर्व अभिलेख नमूनों के द्रव सम्मर्दन से प्राप्त पत्ती और बीज किमान प्ररोह के परिक्षिप्त उपत्वचाओं पर आधारित हैं।

संकेत-शब्द—*वाल्कोमियेला साहनाई* नवजाति, शंकुवृक्ष, आकृतिविज्ञान, उपत्वचा, निम्न गोंडवाना, निम्न पर्मियन।

INTRODUCTION

Conifer remains in Lower Gondwana formations of India are mainly known from the records of *Buriadia* (Lakhanpal *et al.*, 1976; Chandra & Tewari, 1991). The genus is well known by its morphological, cuticular features of sterile and fertile shoot and it is characterized by foliage shoot having heteromorphic leaves, i.e. simple undivided, bifid, multifid, cuneate in shape and fertile axis shows platyspermic seeds on slender stalks (Pant & Nautiyal, 1967). While reinvestigating the specimens of *Buriadia heterophylla*, *B. florinii* and *Birsinghia florinii*, Singh *et al*. 2003 observed that the seeds in all such forms are not in organic connection to shoot, however, our own examination of type specimen of Feistmantel, 1879, no. 5043 preserved at the Museum of Geological Survey of India, Kolkata (designated as Lectotype of *Buriadia heterophylla* by Pant & Nautiyal, 1967) confirms the presence of laterally attached solitary stalked ovules/ seeds with the shoot of *Buriadia heterophylla* (Feistmantel) Seward & Sahni 1920. The other coniferous forms recognized as *Walkomiella indica* Surange & Singh 1951, *Paranocladus? indica* Surange & Lele 1956, *Walkomiella* sp. by Laha (1962), *Searsolia oppositifolia* Pant & Bhatnagar 1975, *Birsinghia florinii* Pant *et al.* 1995, *Paliandrolepis singularis* Pant *et al.* 1995 and *Paranocladus sahnii* Singh *et al.* 2000, show restricted occurrences in West Bokaro, South Rewa and Raniganj coalfields.

During the investigation of plant fossil assemblages of Daltonganj Coalfield, well preserved specimen of

Fig. 1—Foliage shoot of *Walkomiella sahnii* sp. nov. showing spirally arranged ovate-shaped leaves covering the shoot. Scale bar represents 1 cm. BSIP Museum Specimen no. 39677.

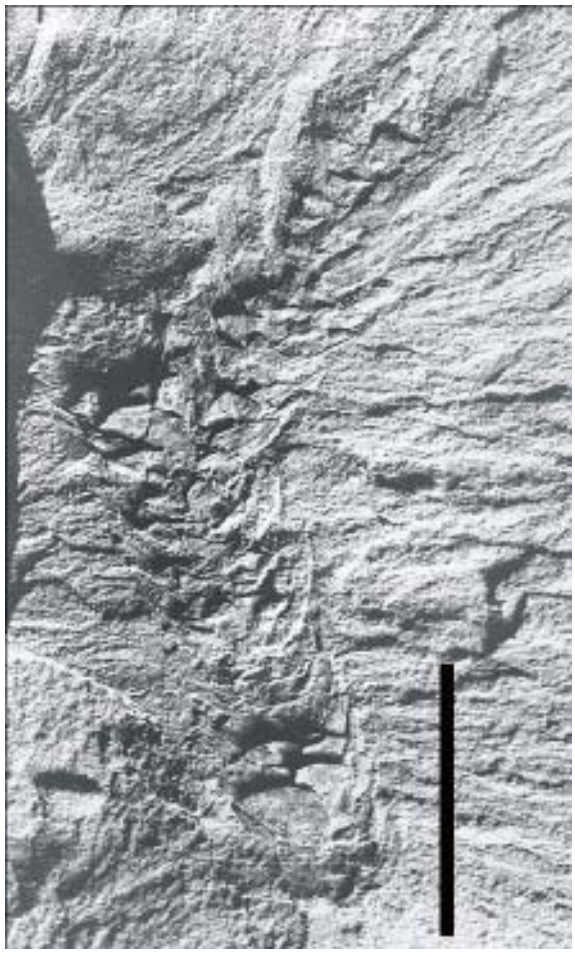

Fig. 2— Counter part of the specimen shown in Fig. 1 showing acuminate apex of leaves. Scale bar represents 1 cm. BSIP Museum Specimen no. 39678.

coniferous foliage shoot with part and counter part is discovered from the shale band lying in between Rajhara bottom seam and Pandwa top seam of Rajhara Colliery belonging to Karharbari Formation (for detail see Maithy, 1969a). The specimen is comparable with the genus *Walkomiella* Florin 1940 and due to its distinct morphological and cuticular character it is attributed to a new species, *Walkomiella sahnii* sp. nov.

The plant fossils from Rajhara Colliery are described for the first time by Feistmantel (1879) and assemblage belong to the species of *Gangamopteris, Glossopteris, Noeggerathiopsis, Vertebraria, Cordaicarpus, Samaropsis* and leafless axes having ridges and furrows with and without nodes and inter nodes. Later Maithy (1969a) carried out palaeobotanical investigations of the area and has examined the mega- and microfossils in detail. The study reveals the presence of *Phyllotheca sahnii, P. crassa, Neomariopteris polymorpha, Gangamopteris cyclopteroides, G. mucronata, G. obliqua, Glossopteris indica, G. communis, Noeggerathiopsis hislopii, Buriadia fragilis, Cordaicarpus zeilleri, Platycardia jugus, Rotundocarpus striatus, Samaropsis goraiensis* and 29 genera and 58 species of miospores. He has observed floral similarity with the plant fossil assemblages of Karharbari Formation of Giridih Coalfield (Maithy, 1969b) as suggested earlier by Feistmantel (1879).

The specimen is preserved as coalified compression with part and counter part. Well preserved cuticular pieces were obtained by macerating the carbonized pull of leaf under usual Schultz solution and to clean the pieces 40% to 50% KOH solution was used. The morphological features were examined under low power binocular and cuticular details were studied and photographed under high power BX 50 Olympus microscope. The type and figured specimens and slides are preserved in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

SYSTEMATICS

CONIFERALES

Genus—WALKOMIELLA Florin 1940

Type species—*Walkomiella australis* Florin 1940

Walkomiella sahnii sp. nov.

(Figs 1-6)

Diagnosis—Foliage shoot sterile, branched, covered with spirally disposed homomorphic, overlapping, rhomboidal-ovate leaves with broad base and acuminate apex, margin smooth, attached with broad

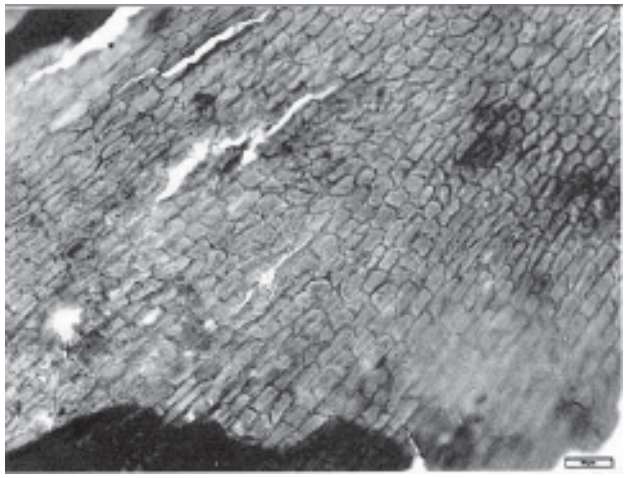

Fig. 3—Cuticle of abaxial surface showing thick narrow-elongate cells. Scale bar represents 100 µm. BSIP Museum Slide No. 13724.

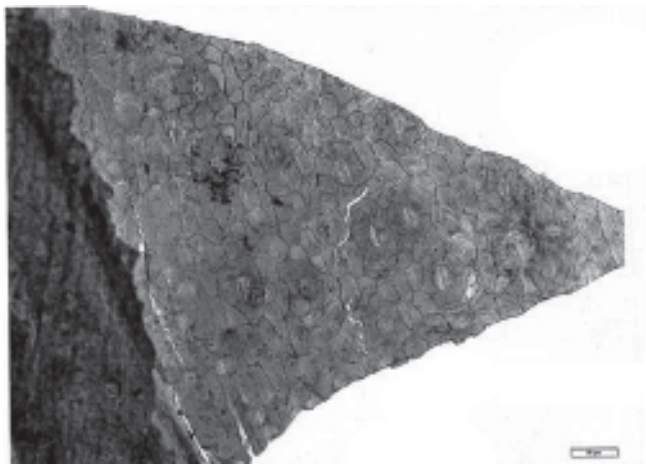

Fig. 4—Cuticle of adaxial surface showing short rectangular cells with irregularly arranged 4 stomata. Scale bar represents 50 µm. BSIP Museum Slide No. 13725.

base, slightly decurrent, marginal leaves slightly bend upwards, each leaf bears a single median vein, cells of abaxial surface thick walled, narrow-elongate, non-stomatiferous, adaxial surface shows thin walled polygonal, rectangular cells, stomata irregularly distributed, 6-7 subsidiary cells, guard cell sunken. Associated fertile structures absent.

Holotype—BSIP Museum Specimen Nos 39677, 39678 and Slide Nos 13724 to 13727.

Horizon & Age—Karharbari Formation, Lower Gondwana, Lower Permian.

Locality—Rajhara Colliery, Daltonganj Coalfield, Jharkhand State.

Repository—Museum of Birbal Sahni Institute of Palaeobotany, Lucknow, India.

Description—The sterile foliage shoot measures 4.2 cm in length, 0.5 cm in width; single branch arises from upper part at an angle of 50 to 55, the branch is 1.5 cm long and 0.4 cm wide, main axis and branch are organizationally similar bearing same type of leaves. Leaves are 3 to 6 mm in length and 0.4 to 0.6 mm wide, rhomboidal, ovate in shape, leathery textured, base broad, apex acuminate, margin smooth and there is no marginal hair or projection. Leaves are attached with the axis by their broad base, the apex of centrally preserved leaves is normally broken, marginal leaves give an appearance of different shape (linear-lanceolate) due to their lateral preservation. Each leaf bears a single median vein emerging from the base. Sometimes leaf surface shows faint striations.

Well preserved cuticular pieces differentiated into non-stomatiferous abaxial and stomatiferous adaxial surfaces have been obtained from the leaves. The cells of both the surfaces are smooth, without papillae and hair-like structures. The abaxial surface shows narrow elongate thick cells, arranged in longitudinal series, size of cells ranges from 90 to 160 µm in length and 25-40 µm in width. The adaxial surface is stomatiferous, with small cells, polygonal and rectangular in shape, straight walled and size ranging from 50 to 70 µm in length and 60 to 70 µm in width. The stomata are sparse, monocyclic and irregularly distributed. There are 6 to 7 subsidiary cells arranged in a ring and their surface is thinly cutinized with thicker cuticles. The guard cells are sunken in a shallow pit lined by overarching subsidiary cells. The stomatal pore is wide and longitudinal in direction.

COMPARISON AND DISCUSSION

Florin 1940 instituted the genus *Walkomiella* with its type species *W. australis* for the forms earlier described by Feistmantel 1878 as *Brachyphyllum? australe* from Upper Permian, Newcastle Series of

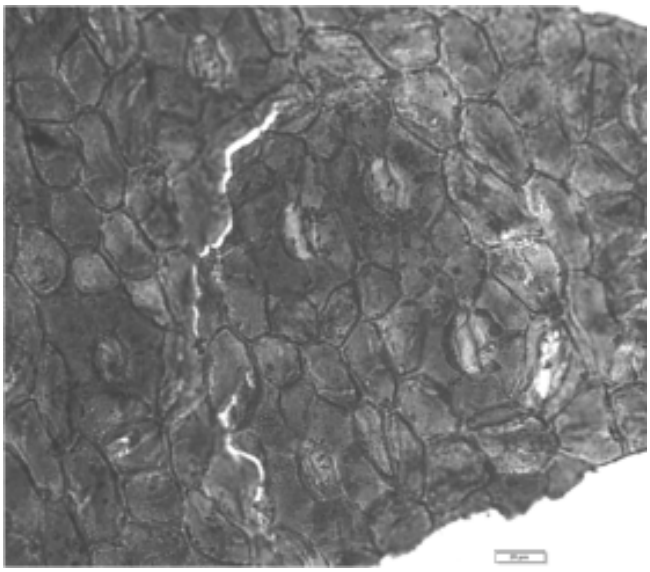

Fig. 5 —Enlargement of cuticular portion shown in Fig. 4 to demonstrate the cell character of lower cuticle. Scale bar represents 20µm. BSIP Museum Slide No. 13725.

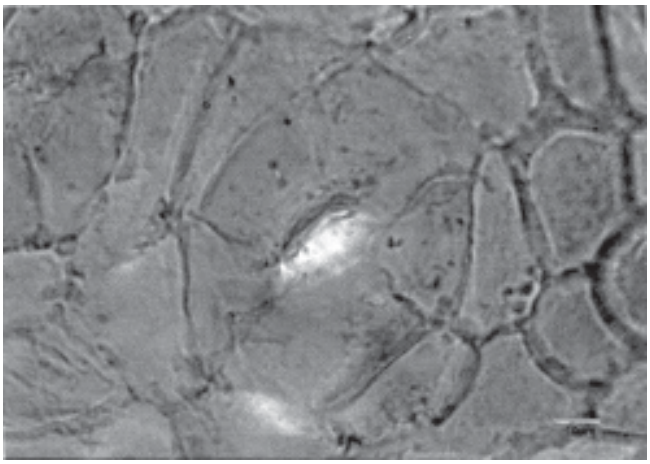

Fig. 6— One stoma showing thinly cutinized subsidiary cells and sunken guard cell. Scale bar represents 10 µm. BSIP Museum Slide Nos 13726, 13727.

Australia. The genus known by three species, viz., *W. australis* (Feistmantel) Florin 1940, *W. indica* Surange & Singh 1951 and *W. transvaalensis* Le Roux 1963 is distributed in Gondwana deposits of India, Australia and South Africa.

The morphological features of present specimen are very much comparable with *W. australis* in having homomorphic, spirally disposed overlapping, leathery textured leaves with broad base but *W. sahnii* sp. nov. is distinct in having comparatively narrow leaves with distinct acuminate apex. *W. indica* described by Surange & Singh 1951 is also different from *W. sahnii* sp. nov. in showing margin of leaves with upwardly curved hair-like toothlets which extend up to just below the acuminate tip. *W. transvaalensis* Le Roux reported from Lower Permian strata of South Africa is distinct from present species in having branchlets which end in a terminal swelling reminiscent of a male cone (Anderson & Anderson, 1985). Moreover all the three species are known by fertile structures whereas *W. sahnii* sp. nov. is based on sterile foliage shoot.

The cuticular features of *W. sahnii* sp. nov. differs from all the species of *Walkomiella* in the absence of papillae and hair-like projections over the surface of cuticular cells and subsidiary cells. The presence of stomatal band on both the surfaces of cuticles and sinuous and toothed cell walls in *W. australis* further differentiates it with *W. sahnii* sp. nov. Similarly presence of unicellular tooth-like hairs at the margins of leaf and sinuous cell wall in non stomatiferous surface of *W. indica* are different from present species.

The most common conifer genus of Lower Gondwana, i.e. *Buriadia* Seward & Sahni 1920 is basically different from *W. sahnii* sp. nov. in having uni-, bi- and multifid heteromorphic leaves. The genus *Paranocladus* Florin 1940 is distinguishable in having cuneate-lanceolate, bifacial/trifacial leaves. Newly instituted genera *Ugartecladus* and *Feruglíocladus* by Archangelsky & Cuneo1987 are mainly based on fertile characters; however their branching pattern and shape of leaves, i.e. lanceolate and acute are quite distinctive. *Searsolia* Pant & Bhatnagar 1975 is distinct in having opposite leaf arrangement whereas *Birsinghia* Pant *et al.* 1995 is known by heteromorphic leaves and fertile shoot. *Paliandrolepis* Pant *et al.* 1995 is a detached elongate, bisporangiate microsporophyll.

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